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Effects of regiolects on the perception of developmental foreign accent syndrome

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Abstract

Foreign accent syndrome (FAS) is a relatively rare speech motor disorder in which the pronunciation of an affected speaker is perceived as distinctly foreign by listeners of the same language community. Because of various close semiological resemblances with apraxia of speech, FAS has been hypothesized to be an apraxia subtype. In 2009 two cases of developmental FAS (dFAS) were described in whom the disorder was detected in an early stage of their speech-language development in the absence of brain damage or mental illness. In the present study, two listening panels consisting of 30 native speakers of two regiolects, Dutch and Flemish, evaluate the spontaneous speech of two native Flemish-speaking boys with suspected dFAS, three native Flemish-speaking children diagnosed with developmental apraxia of speech (DAS), two bilingual children (L1=Flemish, L2=French or English), and six native Flemish-speaking children with typical speech-language development. Whereas the Dutch panellists were not able to distinguish the different groups, the Flemish listeners accurately identified the children with dFAS and the bilingual children. None of the listeners were able to discern between dFAS and DAS. This latter finding supports the assumption that the two speech disorders not only share similar semiological and perceptual characteristics but also a common pathophysiological substrate. Although it is not always identified by listeners of the same language community but is by speakers of the same regiolect, in addition to FAS resulting from brain damage or a psychological disorder, dFAS appears a distinct form of apraxia of speech resulting from developmental deficits.

Keywords:

Bilingual; developmental; Apraxia of speech; Foreign accent syndrome; FAS; regiolect

Introduction

Description

Foreign accent syndrome (FAS) is a relatively rare speech motor disorder in which the pronunciation of the affected speaker is perceived as distinctly foreign by listeners of the same language community. Monrad-Krohn (1947) considered FAS to be a suprasegmental disorder of linguistic prosody, i.e. manifesting in an unfamiliar tone, rhythm, timing, and intonation, giving the speech output, though syntactically and idiomatically correct and comprehensible, an unusual and foreign quality. Still, same-language speakers are often not able to identify the exact geographical location of the accent (Fridriksson et al., 2005).

The French neurologist Pierre Marie (1907) was the first to report on the phenomenon, describing a French-speaking patient from Paris who, after recovering from anarthria due to a lesion in the subcortical left hemisphere, spoke with an Alsatian accent. After Marie's brief communication, a handful of descriptions of similar observations followed. It was not until 1982 that the first diagnostic criteria for FAS were proposed by Whitaker: 1) the accent is deemed foreign by the patient, the patient's relatives, and examiners/researchers; 2) the patient had a different accent before the injury, 3) the accent can clearly be linked to damage to the central nervous system, and 4) there is no reason for the patient to have the accent based on his background. Various descriptions of the characteristics of FAS speech are available. The majority of studies mention segmental issues, such as adaptations of vowel length, substitutions, omissions of phonemes, and suprasegmental issues such as unusual stress in words or sentences (Poulin, Macoir, Paquet, Fossard, & Gagnon, 2007).

FAS mostly occurs in combination with other speech or language disorders, as is the case with many language impairments. Describing 25 FAS patients, Aronson (1990) found 70% to also suffer from apraxia of speech (AoS), aphasia, or dysarthria.

FAS or AoS?

Even after more than a hundred years of multidisciplinary research, we still lack a coherent model of deficient speech that distinguishes FAS from AoS. As the two disorders share speech characteristics, various researchers (e.g. Mariën et al., 2009; Fridriksson et al., 2005; Whiteside & Varley, 1998) posited FAS to be a mild or specific form of AoS caused by a disruption of speech motor planning processes. AoS is a neuromuscular speech disorder in which the precision and consistency of speech movements are affected due to an inability to properly and smoothly convert phonological knowledge to verbal motor commands (Rosenbek, 1999). Based on their acoustic analysis of two recovered FAS cases, Perkins, Ryalls, Carson, and Whiteside (2010) concluded that FAS and AoS share overt similarities. In both conditions, speakers clearly substitute consonants and vowels rather than producing unclear, disrupted speech, as is the case in, among other speech disorders, dysarthria.

Moreover, in both types of affected speech same-language listening panels perceive the accent as non-native.

Aetiology

Whitaker (1982) described FAS as an acquired neurological speech disorder following demonstrable brain damage, which is indeed the case in 83% of adult cases (Keulen, Verhoeven, Bastiaanse, & Mariën, 2014). Although the exact pathophysiological mechanisms subserving FAS remain to be elucidated, several brain areas are often implicated in FAS. Most FAS patients recorded in the literature developed FAS due to focal vascular damage (stroke) in the perisylvian speech area, the frontal motor cortex, or the striatum of the language-dominant hemisphere (Dankovicova et al., 2001). However, various other aetiologies have also been proposed, including head trauma (Edwards et al., 2005), brain tumours (Tomasino et al., 2013; Buentello-García, Martínez-Rosas, Cisneros-Franco, & Alonso-Vanegas, 2011), multiple sclerosis (Villaverde-González, Fernández-Villalba, Moreno-Excribano, Alias-Linares, & Garciá-Santos, 2003), epilepsy (Cole et al., 1971), and dementia (Paolini et al., 2013). As the speech motor symptoms characterising FAS strongly reflect disrupted articulatory planning and coordination, the cerebellum has been suggested to be involved in the physiopathology of both FAS and AoS (Cole, 1971; Whitaker, 1982; Mariën & Verhoeven, 2007; Monrad-Krohn, 1947; Whitty, 1964). Mariën et al. (2009) added that the cerebello-cerebral network may also be implicated in articulatory planning and thus possibly in both FAS and AoS.

Apart from a variety of acquired neurological aetiologies, Verhoeven and Mariën (2010) distinguished three other possible causes of FAS. Firstly, in several cases a psychogenic cause was suspected to lie at the core of the speech problems (psychogenic FAS). After close inquiry no (visible) brain damage or any organic brain disease could be objectified, with strong indications of a psychological or psychiatric disorder remaining (Haley, Roth, Helm-Estabrooks & Thiessen, 2010; Van Borsel, Janssens, & Santens, 2005; Verhoeven, Mariën, Engelborghs, D'Haenen, & De Deyn, 2005). Secondly, both Ryalls and Whiteside (2006) and Verhoeven and Mariën (2010) described a combined variant of neurogenic origin (mixed FAS). In each case the woman concerned had acquired the new accent after brain injury but had subsequently perfected it to boost her personal credibility. Thirdly, and though rare but the most relevant for the present study, FAS has also been documented as a developmental speech disorder in children. Mariën, Verhoeven, Wackenier, Engelborghs, and De Deyn (2009) were the first to report on two patients presenting with neurodFAS which they had incurred in the early stages of their speech and language development in the absence of acquired brain injury or psychiatric symptoms. Their first FAS case involved an adult woman with concurrent AoS who was known to have spoken with a remarkable accent ever since childhood. Their second case, a 7-year-old right-handed boy, presented with specific language impairment in addition to FAS. An in-depth phonetic analysis of speech samples showed that both patients produced deviant speech motor

patterns, which, in a subsequent perceptual experiment, speakers from the same speech community identified as a foreign accent.

In the present study the speech of two Flemish-speaking children suspected of developmental FAS (dFAS) is compared with that of three Flemish-speaking children with DAS and two simultaneous bilingual children (L1= Flemish, L2= French/English) and six Flemish-speaking children with normal speech and language development. We had native adult speakers of Flemish and Dutch, two regional variants of Dutch, assess the speech samples and analysed their perceptual judgments as a whole and per language variant to explore the influence of the two regiolects. The Netherlands and the northern part of Belgium (Flanders) share Dutch as a mother tongue but, although there is a strong common basis, each regiolect has its own phonological, semantic, and even morphosyntactic particularities. As a result both variants can be considered two regiolects (Flemish for Belgium and Dutch for the Netherlands) of one common mother tongue (Dutch).

Based on current insights, it was our expectation that the assessors would identify the children with FAS significantly more often as non-native speakers than they would the other children, assuming that the speech of the bilingual children would not deviate significantly from that of the children with typical speech development given that their bilingual education and language proficiency were both well balanced.

Method

Case descriptions

Two monolingual native Flemish-speaking boys whose speech had FAS qualities were undergoing comprehensive neurolinguistic investigations in a private Speech-Language Pathology and Audiology Clinic in Belgium where their speech was recorded.

Case 1. At the time of language testing B. was six years and four months old. B. was right-handed, had lived in Flanders since birth, was monolingual, i.e. a native speaker of the Flemish regiolect of Dutch, and in his third year of preschool. B. was born at term after normal gestation. His medical history was unremarkable and the family history was negative for developmental disorders and learning disabilities. His language development was, however, not consistent with his age, particularly in terms of language comprehension and vocabulary. He also presented with word finding difficulties and used incoherent and insufficient narrative structures when speaking. Normal intelligence can be assumed but was, unfortunately, not formally assessed. Formal language assessments using the Dutch version of the Clinical Evaluation of the Language Fundamentals (SELF; Kort, Schittekatte, & Compaan, 2008) showed outcomes to be within the average or low-average range, ruling out a primary developmental language disorder (see Table 1).

Table 1: CELF-4 Index scores for Case 1 (6;4 years)

Language Index	**NS**	**Pc**	**Interpretation**
Core Language Score	90	25	Average
Receptive Language Index	95	36	Average
Expressive Language Index	94	34	Average
Language Content Index	90	25	Average
Language Structure Index	89	23	Low average

Note. NS: norm score (M = 100, SD = 15); Pc: percentile score (M = 50, SD = 13,5)

Irrespective of his average language skills, B.'s speech production was inappropriate for his age. The test administrator (WT) characterised his pronunciation as remarkable, containing both sigmatism and rhotacism. B. had difficulty articulating the uvular r correctly and prolonged and sharpened vowels, giving them an unnatural stress. Initially, the test administrator did not recognise the accent as foreign but, listening to the audiotape of the first session, he judged the accent to be French. As evidenced by a pathological score (Pc 3) on the diadochokinesia subtest of the NEPSY-II (Dutch version; Zijlstra, Kingma, Swaab, & Brouwer, 2010), speech motor planning was also disrupted. Neurological and otorhinolaryngological investigations showed no abnormalities.

Case 2. L. is a 14-year-old, right-handed, native Flemish-speaking boy growing up in Flanders who was referred for a neurocognitive work-up because of learning difficulties and attention problems in school. He was born at term after normal gestation. Attending the second year of secondary education, L. had had four years of formal instruction in French (second language): two years in primary school (maximum two hours/week) and two in secondary school (maximum five hours/week). He had recently started taking English as a third language (maximum two hours/week). His medical history was unremarkable and the family history was negative for developmental disorders and learning disabilities. However, according to the WHO child growth standards the acquisition of gross motor milestones was delayed. L. could sit without support and stand with assistance at 8 months (mean = 6.0 and SD = 1.1; 7.6 and 1.4, respectively) but did not crawl or walk independently until the age of 20 months (mean = 12; SD = 1.8 months). He was able to ride a bicycle independently at age 7. By the age of 4-5 years L. had developed a clear right-hand preference. He had never been good at sports and writing had always been problematic, with his handwriting remaining difficult to read. L. had only begun to speak at the age of two and a half and remained hard to understand, even for his parents. Once in school, his speech and language skills improved but were still below age-appropriate levels. At age 6, L. started speech and language therapy (SLT) and although the treatment was beneficial, performance remained below expectations. After SLT discontinuation at age 8, L.'s speech

was still nonfluent and marked by severe word finding difficulties, frequent repetitions, interruptions, and false starts. He complained of having problems understanding instructions at school. His attention problems seemed to relate strongly to deficient auditory and written-information processing. He called himself more of a picture thinker. According to his parents, L. did not talk much, adopting a wait-and-see attitude in conversations and getting easily overruled by others. Neurological and otorhinolaryngological investigations performed at the age of 14 were normal. EEG and CT scan of the brain did not disclose any abnormalities. Neurocognitive test results are shown in Table 2.

Table 2: Neurocognitive test results Case 2 (14;0 years)

	NS	**Pc**	**Interpretation**
Intelligence (WISC-III; Kort et al., 2005)			
Verbal IQ	112	79	High average
Performance IQ	92	30	Average
Total IQ	103	58	Average
Verbal comprehension	112	79	Average
Perceptual organisation	94	34	Average
Processing speed	80	9	Low average
Language (CELF-4; Kort et al., 2008)			
Core language score	103	56	Average
Sentence repetition	85	16	Low average
Sentence formulation	120	91	High average
Definitions	100	50	Average
Word categories total	105	63	Average
Fine motor skills (Beery VMI; Beery, Buktenica, & Beery, 2003)			
Visual-motor integration	75	5	Borderline
Visual perception	93	32	Average
Motor coordination	77	6	Borderline

Note. NS: norm score (M = 100, SD = 15); Pc: percentile score (M = 50, SD = 13,5)

With a total IQ of 103 on the Wechsler Adult Intelligence Scale-III (WISC-III), L.'s general cognition was normal, while his IQ profile was marked by a significant discrepancy of 20 IQ points ($p < .05$) between his verbal IQ (112; high average) and his perceptual IQ (92; average). Analysis of the subtest results revealed a low-average score for 'Block Design' (Pc 9; -1.33 SD) and 'Object Assembly' (Pc 16; -1.0 SD). A formal assessment of language functions using the CELF-4 (Kort et al., 2008) showed an average core-language score (Pc 56). On the subtest 'sentence formulation' L. had scored within the high average range (Pc 91; +1.33 SD). No evidence of ungrammatical speech was found. L.'s scores for 'Sentence repetition' fell within the low average range (Pc 16; -1.0 SD) and for

semantics in the average range (Pc 5-63). The test administrator (WT) perceived the boy's speech as distinctly foreign, i.e. German-like, right from the start, mainly due to L.'s frequent production of guttural speech sounds, with the many interruptions, repetitions, and false starts adding to the foreignness.

Fine motor skills were tested using the Beery Developmental Test of Visual-Motor Integration (Beery, Buktenica, & Beery, 2003). L. obtained a clinically deficient result on the visual-motor integration part (Pc 5; -1.67 SD) whereas his scores for visual perception were within the average range (Pc 32; -0.5 SD). Fine motor coordination problems were reflected by a clinically deficient score on the visual-motor coordination subtest (Pc 6; -1.5 SD). A qualitative analysis of L.'s handwriting confirmed fine motor coordination problems: although fluent, it showed inadequate letter connections and spacing. Oral diadochokinesia testing (NEPSY; Zijlstra et al., 2010) also disclosed a clinically abnormal result (Pc 5; -1.67 SD) in terms of an inconsistent error pattern.

Additional multidisciplinary assessments, including a psychiatric investigation, were consistent with a diagnosis of developmental coordination disorder (DCD) associated with DAS and FAS. An attentional deficit disorder or a specific learning disability was formally ruled out.

Control participants

Besides the spontaneous speech recordings of the two Flemish-speaking boys with FAS, we had the panel evaluate similar speech samples of three native Flemish-speaking children with DAS, two typically developing simultaneous bilingual (TD-BL) children (L1= Flemish, L2= French/English), and six typically developing monolingual (TD-ML) Flemish-speaking children with no known cognitive disabilities. The mean age of the combined controls was 9 years and 7 months (SD = 3.01). The WISC-III (Kort et al., 2005) showed all children to be of normal intelligence (IQ > 85). Except for the three children with DAS, the controls had no formally attested cognitive disabilities; the DAS group had no comorbid conditions. Handedness was not formally assessed in the controls but parental reports showed only one (bilingual) child to be left-handed. Demographic data of the control group is presented in Table 3.

To facilitate comparisons with the two FAS boys, we divided the controls into two age groups: a group of six children aged between 5 and 10 years to match Case 1 and a group of five children aged between 10 and 15-years to match Case 2.

Table 3: Description of the boys with FAS and the controls per age group.

Initials	**Gender**	**Age**	**Handedness**	**Lingual category**	**No. of speech samples**	**Age group**
Case 1	M	6	R	**FAS**	3	5-10
Control 1	M	10	L	TD-BL	3	5-10
Control 2	M	7	R	TD-ML	1	5-10

Control 3	M	8	R	TD-ML	1	5-10
Control 4	M	6	R	TD-ML	1	5-10
Control 5	M	7	R	DAS	2	5-10
Control 6	F	7	R	DAS	1	5-10
Case 2	M	14	R	**FAS**	3	10-15
Control 7	M	10	R	DAS	3	10-15
Control 8	F	12	R	TD-BL	3	10-15
Control 9	M	13	R	TD-ML	1	10-15
Control 10	M	13	R	TD-ML	1	10-15
Control 11	M	13	R	TD-ML	1	10-15

Note. M = male; F = female; R = right-handed; L= left-handed; FAS = Foreign Accent Syndrome; TD-BL = typically developing bilingual (Flemish and French); DAS = developmental apraxia of speech; TD-ML = typically developing monolingual (Flemish).

Assessors

Fifteen adult Dutch and as many Flemish lay persons were recruited (in the circle of acquaintances of the first two authors) to judge the speech samples in a perceptual experiment. None had spent longer than six months outside the Netherlands or Belgium (Flanders). We included assessors with Dutch as their native language to investigate the potential influence of regional variability. The assessors were all unaware of the purpose of the study. None were linguists or speech therapists, nor did they have any formal knowledge of speech or language disorders. Twelve of the assessors were men and 18 women; ages varied between 19 and 63 years, with an average of 28 years (*SD* = 8,55). All had normal hearing. Although there was a significant difference in the mean ages of the Dutch (M = 22; SD = 2,08) and the Flemish panellists (M = 33; SD = 9,3), $U = 8{,}5$, $p < .05$), we assumed that age would not influence the quality of their perceptual judgments. Demographic details of the assessors are shown in Table 4.

Table 4: Demographic details of the assessors

Respondent	Native Language	Gender	Age
1	Dutch	M	26
2	Dutch	F	21
3	Dutch	M	27
4	Dutch	M	23
5	Dutch	F	23

6	Dutch	M	19
7	Dutch	M	21
8	Dutch	F	22
9	Dutch	F	22
10	Dutch	F	24
11	Dutch	F	22
12	Dutch	M	25
13	Dutch	F	22
14	Dutch	F	23
15	Dutch	M	21
16	Flemish	F	37
17	Flemish	M	35
18	Flemish	F	35
19	Flemish	F	34
20	Flemish	F	25
21	Flemish	M	24
22	Flemish	F	32
23	Flemish	M	63
24	Flemish	F	39
25	Flemish	F	29
26	Flemish	F	30
27	Flemish	F	29
28	Flemish	M	25
29	Flemish	F	31
30	Flemish	M	32

Note. F = female; M = male; Age is in years.

Stimuli

The speech of the FAS boys and the controls was recorded by the first author using the same recorder in a quiet room in the presence of a parent. Each assessor was presented a total of 24 short audio recordings of spontaneous speech in identical order. Mean length per recording was 9 seconds (SD = 5 sec). In the samples, the children talked about their hobbies or holidays. For each age group (5-10 years matching Case 1; 10-15 years matching Case 2) 12 samples were included, three for each group under study, i.e. the relevant FAS case, the children with DAS, the bilingual and the monolingual children. All audio recordings were randomised and edited into one take. We opted for audio rather than video recordings to exclude any secondary behaviour (such as gesturing) from influencing the listening panel's judgments.

Procedure

Seated in a quiet and dimmed room, each member of our listening panel was fitted with headphones to guarantee maximum sound quality, after which s(he) was handed a dedicated score form stating the instructions to listen carefully to the audio recordings, which would be presented once only. The assessor was further instructed to indicate within six seconds how confident s(he) was with regard to the accent using a 5-point Likert scale and to select 1 when (s)he was absolutely certain that the speaker was not a native speaker of Dutch and 5 when the speaker most certainly was a native speaker of Dutch. If a score other than 5 was selected, s(he) was instructed to write down which accent s(he) perceived (e.g. Polish) in the designated space. We opted for a 5-point scale to reduce the choice of extremes while prompting the assessors to be specific in their judgments. In contrast to a 7-point scale, a 5-point scale affords the assessor a better overview and more straightforward ratings options. When the assessor started the recorder, the number of speech samples to be assessed was stated followed by a beeping sound, after which the samples were presented. The beep sounded again to indicate the end of the stimulus presentation and the start of the 6-second rating interval; after 6 seconds another beep indicated the start of the next stimulus presentation. If necessary, the assessor (the first two authors) remained present to oversee the procedure and could pause (but not rewind) the stimulus presentation.

Data analysis

We used a Friedman test to identify potential differences among the linguistic categories for all assessors. A post-hoc Wilcoxon signed-rank test was then performed to further analyse the resulting significant differences. Significance was set at $p < .05$ for all tests. In order to examine potential effects of regional variance, we ran separate analyses on the data of the Dutch and Flemish assessors and correspondence analyses for the foreign language accents attributed to the two FAS cases.

Results

Table 5 provides the descriptive statistics for the Dutch and Flemish assessors separately and for all assessors (All) per speech category: suspected FAS, DAS, bilingual (TD-BL), and monolingual (TD-ML). The bar graph depicted in Figure 1 shows the results schematically allowing for easy comparison.

Table 5: Speech accent ratings per linguistic category for the Dutch and Flemish assessors and all assessors combined

Speech category	**Assessors**	**Min**	**Max**	**M**	***(SD)***	**Median**
FAS	Dutch	2.17	5.00	3.58	*(0.92)*	3.50
FAS	Flemish	1.33	4.33	2.92	*(0.83)*	3.00
FAS	All	1.33	5.00	3.25	*(0.92)*	3.17
DAS	Dutch	2.67	4.83	4.06	*(0.63)*	4.17
DAS	Flemish	2.50	4.33	3.38	*(0.53)*	3.50
DAS	All	2.50	4.83	3.72	*(0.67)*	3.83
TD-BL	Dutch	3.00	4.83	4.00	*(0.54)*	4.17
TD-BL	Flemish	3.00	4.83	4.07	*(0.50)*	4.33
TD-BL	All	3.00	4.83	4.03	*(0.51)*	4.17
TD-ML	Dutch	3.50	5.00	3.99	*(0.54)*	3.67
TD-ML	Flemish	3.17	5.00	4.47	*(0.52)*	4.50
TD-ML	All	3.17	5.00	4.23	*(0.57)*	4.17

Note. Min = lowest average score on 5-point scale; Max = highest average score on 5-point-scale; FAS = suspected Foreign Accent Syndrome; TD-BL = typically developing bilingual; DAS = developmental apraxia of speech; TD-ML = typically developing monolingual (Flemish); Dutch = all Dutch assessors; Flemish = all Flemish assessors; All = all assessors collectively.

The results of the Friedman test showed a significant discrepancy for the linguistic categories, χ^2 (3, N = 30) = 25.21, p = 0.001. With a mean of 3.25 on the 5-point Likert scale the FAS group

obtained the lowest score of all assessors, indicating the accent to be 'most likely of foreign origin.' Compared to the speech of the DAS (M = 3.72) and bilingual children (M = 4.03), the monolingual children had been awarded the highest score (M = 4.23), i.e. the lowest attribution of a foreign accent.

The subsequent Wilcoxon test showed the scores for the FAS samples to be markedly different from the scores for the other speech samples: DAS z = -2.47, p = 0.01; TD-ML z = -3.94, p = 0.001, and TD-BL z = -4.05, p = 0.001.

The ratings of the Dutch assessors deviated from those of the full panel in that the order of the other groups differed. Although they had identified a foreign accent in the FAS children (M = 3.58), they had awarded the TD-ML group an average score of 3.99, the TD-BL group M = 4.00, and the DAS group the highest score (M = 4.06), identifying the latter children as the least likely to be of foreign descent. The Friedman test showed the differences not to be significant, χ^2 (3, N = 15) = 3.804, p = 0.283 rendering post-hoc analyses superfluous.

The order of the ratings of the Flemish assessors did correspond to that of the full panel ratings (FAS (M = 2.92) < DAS (M = 3.38) < TD-BL (M = 4.07) < TD-ML (M = 4.47)). The Friedman test revealed significant differences for the speech categories, χ^2 (3, N = 30) = 32.76, p = 0.001. The subsequent Wilcoxon test indicated that the scores for FAS speech were not significantly different from those for DAS speech, z = -1.80, p = 0.07 but that these ratings did differ significantly from the scores for the TD-BL (z = -3.41, p = 0.001) and the TD-ML samples (z = -3.30, p = 0.001).

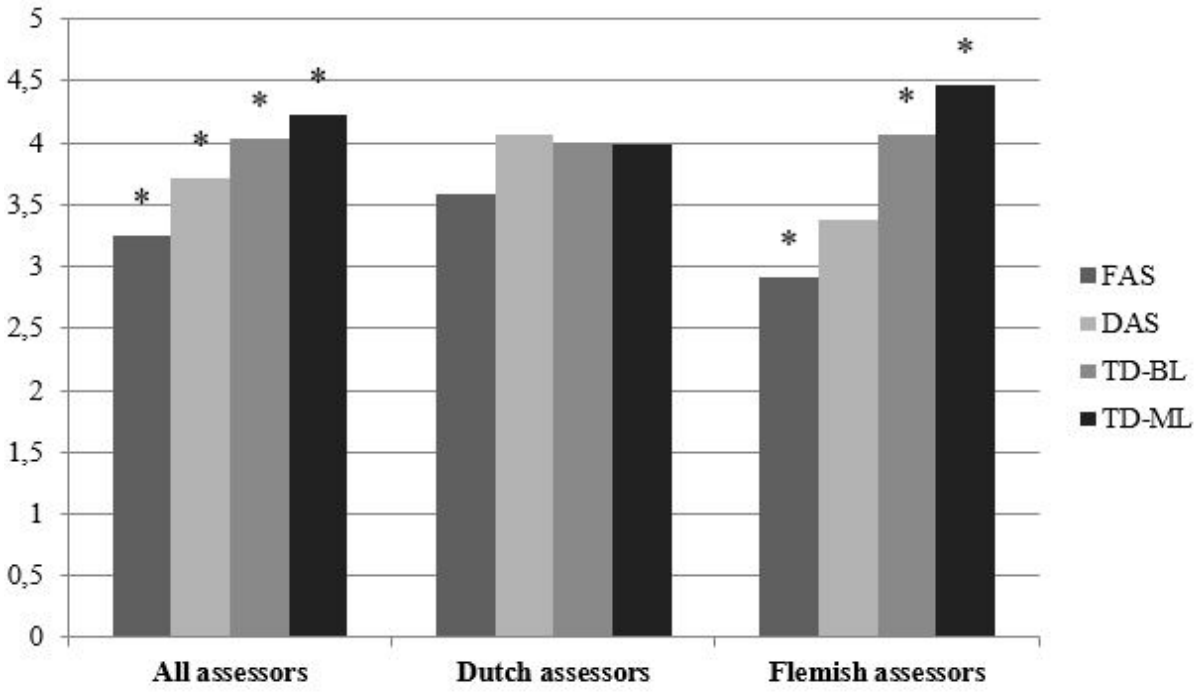

Figure 1. Average rank score per linguistic category for all assessors collectively and for the Dutch and Flemish assessors separately. Asterisks (*) indicate a significant discrepancy ($p < 0.05$). FAS = foreign accent syndrome; DAS = developmental apraxia of speech; TD-BL = typically developing bilingual (Flemish and French); TD-ML= typically developing monolingual (Flemish).

Having awarded a score other than 5, the assessors indicated which language they perceived to be the child's mother tongue. The different languages the assessors attributed to the children with FAS were analysed next.

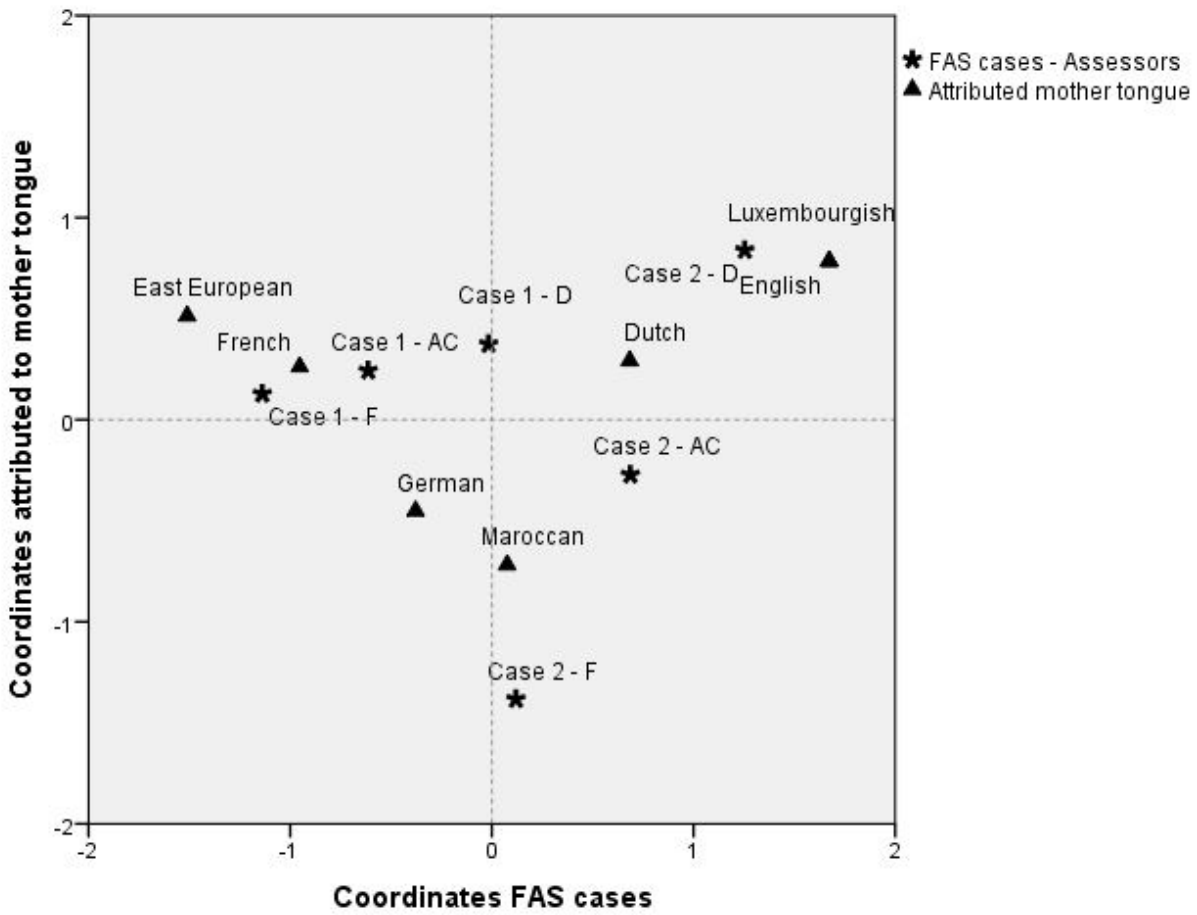

Figure 2. Correspondence analysis indicating the intensity of the relationship between the FAS speaker and the designated native language. The results are depicted for all assessors collectively (AC) and for the Dutch (D) and Flemish assessors (F) separately.

Of the collective assessors who regarded Case 1 as a non-native speaker of Flemish, 44.7% judged him to be a native speaker of French, with the languages from the neighbouring countries of Belgium (Flanders) also being quoted, among which were Dutch (as spoken in the Netherlands) (27.7%) and German (23.4%). Remarkably, both Moroccan and Eastern European languages were also suggested (both 2.1%). The Flemish assessors gave French as the mother tongue (56%) more consistently than their Dutch peers did (31.8%).

As to Case 2, 57.1% of the collective assessors mentioned Dutch, the regiolect of the Netherlands, as his mother tongue, with German also being reported (19%) as well as other Western European languages, among which were French (7.1%), English (2.4%), and Luxembourgish (2.4%). Other languages mentioned included African (general) (2.4%), Turkish (7.1%), and Moroccan (2.4%). Of the Dutch assessors, the vast majority (85.7%) considered Dutch (their own native regiolect) to be his native language, whereas only 28.6% of the Flemish respondents did. The latter assessors had further attributed Case 2 a German accent (33.3%) but also a French (14.3%), Turkish (14.3%), Moroccan (4.8%), and a general African (4.8%) accent.

Discussion

In the present study, a naive Dutch- and Flemish-speaking listening panel perceptually assessed spontaneous speech samples of two Flemish-speaking boys with suspected developmental foreign accent syndrome (dFAS), together with similar recordings of age-matched groups of Flemish-speaking children with developmental apraxia of speech (DAS), typically developing bilingual (Flemish and French) and monolingual (Flemish) children. We had invited both Dutch and Flemish assessors to enable us to examine the potential effects of the two regiolects on the speech ratings, Dutch being spoken in the Netherlands and Flemish in Flanders, Belgium, respectively.

The results showed that the entire panel had identified the two boys with dFAS as the ones sounding most foreign. The results for all other groups differed significantly from each other, confirming our hypothesis that children with FAS are perceived as sounding more foreign than children with DAS, while the latter children are perceived to sound more foreign than typically developing bilingual and monolingual children, in that order.

However, focusing in on the results per regiolect, we found significant differences. The vast majority of the Flemish panellists deemed the speech of the boys with FAS to sound the most foreign of all groups and different from the other samples, but the difference between FAS and DAS did not reach significance. Most Dutch assessors also perceived the FAS accents as sounding the most foreign but not significantly different from the other groups; the differences in their ratings were minor. Thus, speaking another variant of Dutch than the children they assessed, the Dutch judges were not able to convincingly distinguish discrepancies in the speech of the various groups, while their Flemish counterparts that spoke the same regiolect as the children were not able to perceive significant differences in the speech quality of the children with FAS and DAS.

Unexpectedly, the Flemish panel awarded significantly lower scores to the bilingual children, thus clearly distinguishing them from their monolingual age peers. This was contrary to our expectations given that these children had all received a similarly well-balanced education. Possibly, when speaking Flemish, the bilingual children presented with subtle segmental or suprasegmental features reminiscent of French.

Many of the judges left the question about the nature of the foreign accent they had perceived unanswered or indicated that they had no idea. Only in half of the cases a suggestion was provided. With respect to the children with FAS, one accent was consistently put forward: French for Case 1 and the Dutch regiolect for Case 2. In Case 1 the choice coincided with the initial assessment (WT) but for case 2 it did not. Here, the accent had initially been identified as German, which was the second most cited language after Dutch. Again, there were marked differences in the judgments of the Flemish and Dutch assessors. The Flemish assessors were decisive in their choice of a French accent for Case 1, which might be due to the fact that Flemish people are quite often exposed to French, one of the official languages in Belgium (spoken in the southern parts of the country). Surprisingly, most Dutch

assessors perceived the FAS accent of Case 2 as a variant of Flemish, i.e. a variant of his own regiolect. Overall, the results demonstrate that the assessors had all distinguished FAS from normal speech but that they were not certain of nor unanimous in their choice of accent. This is in line with the study by Fridriksson et al. (2005) that showed that, although speakers of the same native language were able to identify a deviation in the language of FAS patients, they were inconsistent in their identification of the accent. Arguably, assessors speaking the same language or regiolect tend to select languages spoken in neighbouring countries.

To our knowledge, we were the first to investigate the effects of regiolects on the perception of FAS. Previously, listening panels consisted of same-language native speakers that were generally viewed as a single, homogeneous group, but with our mixed panel we have shown that regional variances of Dutch can significantly influence the raters' judgments. The assessors speaking the same regiolect as the speakers they were assessing were more susceptible to accent differences in the spontaneous speech samples, while their interpretations of the accent were also more consistent than was the case for the assessors fluent in another regiolect. Our study accordingly merits to be expanded, with future research taking regional variants of other languages into account.

Especially the results of the Flemish assessors suggest that in the Flemish regiolect the speech characteristics of FAS and DAS are more closely linked than those of FAS and typically developing bilingual and monolingual children. Several studies have shown that, from a perceptual point of view, the pattern of segmental and suprasegmental features discerned in speakers suffering from FAS resembles the speech patterns of individuals coping with AoS (Fridriksson et al., 2005; Mariën et al., 2009; Perkins et al., 2010; Poulin et al., 2007; Whiteside & Varley, 1998). Based on our findings, we propose that, at the perceptual level, dFAS relates to DAS in a similar fashion as neurogenic FAS does to apraxia of speech (AoS). To confirm our hypothesis, further study of dFAS cases in other languages is recommended.

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